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Issued July 8, 1916.

GUAM AGRICULTURAL EXPERIMENT STATION,

A. C. HARTENBOWER, Agronomist in Charge.

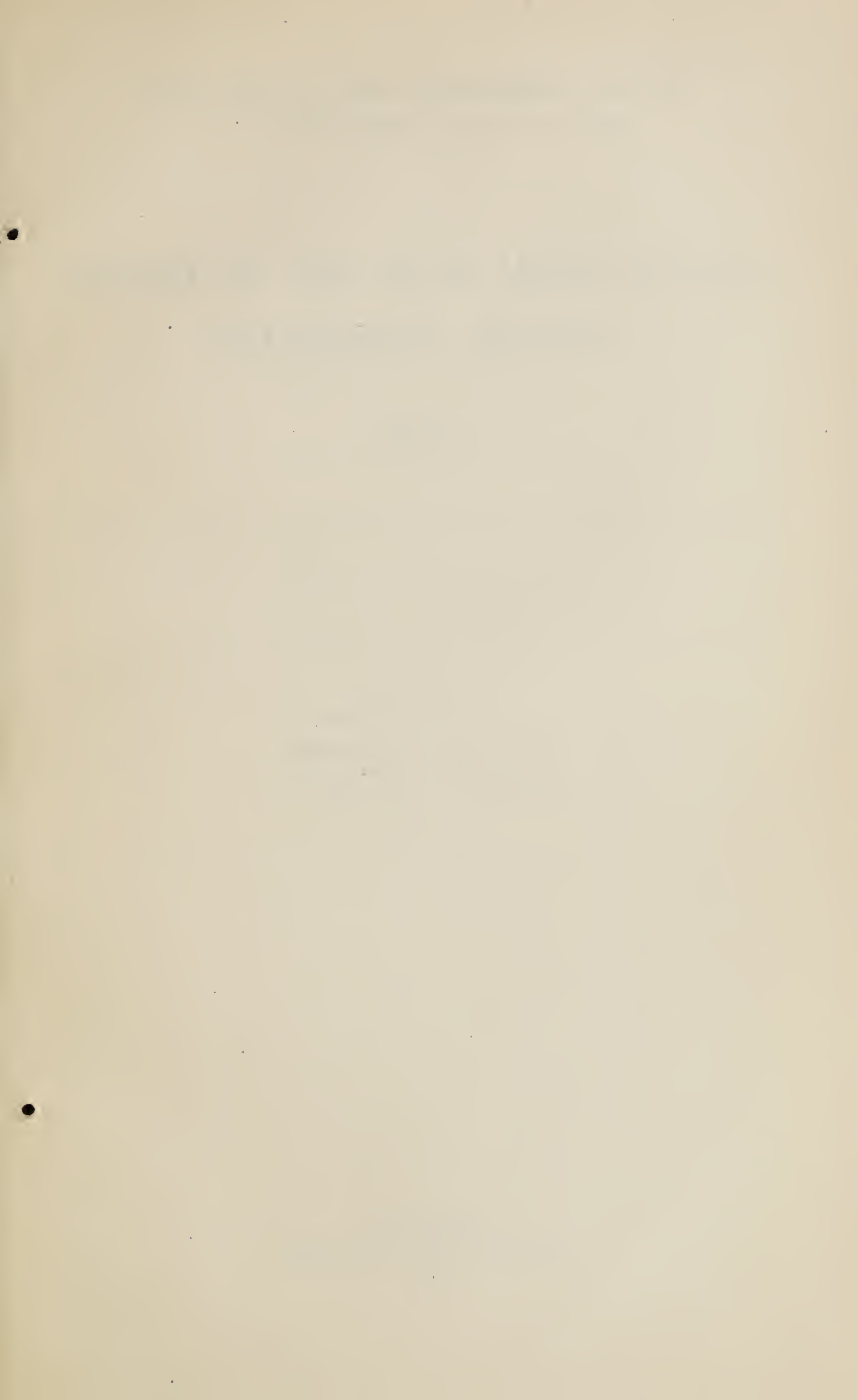


REPORT OF THE GUAM AGRICULTURAL
EXPERIMENT STATION.

1915.

UNDER THE SUPERVISION OF
STATES RELATIONS SERVICE,
Office of Experiment Stations,
U. S. DEPARTMENT OF AGRICULTURE.

WASHINGTON:
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GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM.

[Under the supervision of A. C. TRUE, Director of the States Relations Service, United States Department of Agriculture.]

E. W. ALLEN, *Chief of Office of Experiment Stations.*

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STATION STAFF.

A. C. HARTENBOWER, *Agronomist in Charge.*

L. B. BARBER, *Veterinarian and Animal Husbandman.*

PETER NELSON, *Assistant.*

LETTER OF TRANSMITTAL.

GUAM AGRICULTURAL EXPERIMENT STATION,

Island of Guam, July 24, 1915.

SIR: I have the honor to transmit herewith a report of the Guam Agricultural Experiment Station, 1915.

Very respectfully,

A. C. HARTENBOWER,

Agronomist in Charge.

Dr. A. C. TRUE,

Director States Relations Service,

U. S. Department of Agriculture, Washington, D. C.

Publication recommended.

A. C. TRUE, *Director.*

Publication authorized.

D. F. HOUSTON, *Secretary of Agriculture.*



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REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION, 1915.

REPORT OF THE AGRONOMIST IN CHARGE.

By A. C. HARTENBOWER.

INTRODUCTION.

During the past fiscal year the equipment in small buildings, water system, live stock, pastures, feeds, machinery, plants, seeds, etc., was extended so as to enable the station to undertake more detailed experimental work and to be of consequently broader usefulness to the native ranchers of Guam.

It was realized at the beginning of the year that the equipment was not sufficient in amount to permit the carrying out of such experimental work in agronomy, animal husbandry, horticulture, and veterinary medicine as seemed desirable. Necessarily, therefore, the greater portion of the time of those connected with the station has been occupied not only in carrying on the experimental work already in progress, but also in arranging details for starting the new experiments planned. Until near the end of the fiscal year, no new experiments were started, except with corn, cotton, hog feeding, and disease investigations.

NEW EXPERIMENTS UNDERTAKEN.

The following projects were approved and experiments were started on them during the year, or the equipment arranged for starting them about July 1, 1915:

Agronomy.—Cotton: Variety tests, cultural methods, and improvement. Corn: Variety tests and improvement. Rice: Variety and fertilizer tests. Alfalfa: Soil and inoculation tests. Cowpeas and soy beans: Variety and inoculation tests; value for hog pastures. Para grass: Studies of production and fertilizer tests.

Horticulture.—Vegetables: Variety and fertilizer tests; loss of vitality of seeds under Guam conditions; effect of Guam conditions in the degeneration of vegetables. Lemons and oranges: Improvement by asexual methods. Coconuts: Variety and fertilizer tests; cultivation; growth in combination with different pasture grasses.

Animal husbandry.—Coconuts as feed for young chicks; effects of tick infestation on the temperature and growth of native Guam cattle; effects of tick infestation on imported cattle, together with a study of methods of tick eradication; normal temperatures of horses, cattle, and carabao in Guam; coconuts and breadfruit *v.* corn and shorts in hog feeding; native rations *v.* imported rations for egg production; cowpeas, soy beans, peanuts, and Para grass as pastures for hogs.

Veterinary medicine.—A study of the live-stock diseases of Guam.

PROPOSED EXPERIMENTS.

The following experiments have been outlined and will be started during the first six months of the next fiscal year: Tobacco: Variety, fertilizer, and insect enemy studies. Horse feeding: Para grass *v.* alfalfa hay. Silos: Value; keeping qualities of silage under Guam conditions.

IMPROVEMENTS AND REPAIRS.

The improvements made during the year were such as to enable the station to take up further investigational work, provide protection for live stock, machinery, tools, medicines, etc., and permit orderly care, as well as improve the station's appearance in general. The different buildings were repainted, it being recognized that their durability was increased thereby.

A 12 by 18 foot addition was built to the carriage and wagon shed. This addition was divided into two parts, one part serving for a tool room and the other for a medicine and veterinary instrument room. The tool room with its shelves and holders permits a systematic arrangement, and as it is under the care of but one man who uses a check system with the other laborers, the loss and misplacing of tools seems to have ended. The medicine room is equipped with shelves and a table, and as soon as possible a sink will be put in.

Until recently, there has been no provision for brooding chicks after taking them from the incubator. In order to relieve that situation a brooder house 30 by 6½ feet was constructed. It is divided into three sections of equal size, 10 by 6½ feet, and each section has a run 10 by 10 feet made of 1-inch mesh galvanized wire, with 3 by 4 inch posts and 1 by 6 inch baseboards set in concrete for supporting the wire. Gasoline heaters with homemade galvanized-iron hovers are ready to be installed for providing artificial heat when needed.

To go with the brooder house, three growing coops, 4½ by 6 feet, were built in accordance with the plan adopted by the department for its poultry farm at Beltsville, Md. The only variation from the above plan consisted in making one door open downward and the



FIG. 1.—STATION RESIDENCE.



FIG. 2.—ENLARGED POULTRY PLANT.



FIG. 1.—PARA GRASS AT INARAJAN.



FIG. 2.—HEDGE AND ORNAMENTAL PLANTS AT INARAJAN.

other upward, thereby providing for the entrance of more sunshine and for the elimination of drafts when the door is open. Runs of an average size of 35 by 75 feet have been built around each of the coops.

An addition was also made to the equipment for the breeding and laying flocks. This gives the station 13 hen runs. These will be utilized as follows: Six for breeding flocks of pure breds, cross breds, and natives; 4 for experimental work in feeding for egg production; 2 for laying flocks of Brown Leghorns; and 1 for a laying flock of the No. 11 cross-bred chickens, the most promising laying strain of chickens containing native Guam blood.

Trap nests which the station had on hand were installed in April, and, after being slightly changed, they are now giving satisfaction. The accompanying illustration shows the enlarged poultry plant of the station. (Pl. I, fig. 2.)

Two portable goat houses, each 6 feet wide by 8 feet long by $6\frac{1}{2}$ feet high at the front and $5\frac{1}{2}$ feet at the back, with corrugated galvanized-iron roofs, were built near the end of the fiscal year. A 6-by-8-foot portable hog house was also built, and material was purchased for another. Four farrowing pens, with board floors made in two sections and with railings around the sides, were constructed in the station's concrete hog house. A shed 30 by $8\frac{1}{2}$ feet with a galvanized-iron roof was erected in the new mare pasture to protect the mares from the hot sun of the dry seasons and from the heavy rains in the wet seasons.

A new shingle roof was placed upon the station residence. (Pl. I, fig. 1.) Shingle roofs have not been used in Guam, and the experiment at this station should prove of value. The shingles used were of California redwood, and before being laid they were given treatments of coal tar or linseed oil, or both, and all were then painted with coal tar after being laid $3\frac{1}{2}$ inches to the weather. The cost of the shingle roof was considerably less than if galvanized roofing had been again used.

Considerable attention was given to improving the hill on which the station residence is located. The hill was cleared of weeds and brush, grass was planted, and concrete steps built. Soil from one side of the hill was spread about 2 feet thick on top of the cascajo (gravel) and Bermuda grass was planted as a lawn before the house. Walks were put in and a hedge of *Barleria cristata* was planted around the house. Flowering shrubs were later added to the lawn.

The water supply of the station during the dry seasons had become entirely inadequate. Not only was the flow of less than 400 gallons of water per day in the old, open, unwallled well insufficient for the

bare needs of the station's live stock, but also the water obtained was badly contaminated. Irrigating directly from the well had become impossible, and almost all of the water used on the garden and trees during the dry seasons was hauled some distance. A reliable water supply was, therefore, of the greatest importance. About March 15 work was started on a new well in the bed of the Masso River, where in normal seasons during about five months of the year there is no flowing water. The digging was continued to a depth of about 21 feet below the surface of the ground, or 11 feet below the bed of the river. A recent test showed that the well would supply at least 9,000 gallons of water each 24 hours. To prevent contamination and caving in, the well was inclosed with a 6-inch concrete wall, with a concrete slab on top. The new well has an almost inestimable value to the station. The live stock is assured of pure water, and during dry seasons light irrigations can be given to the orchards and gardens, and possibly to the hog pastures. Since the well has given such large supplies of water at the end of a dry season of exceptional intensity, there would seem to be no doubt but that the water problem is solved for the present.

In order to pump the water into the station's concrete reservoir, of about 20,000 gallons capacity, situated on a hill about 85 feet above the well, a 2-horsepower engine, directly connected to a pump, was installed and a 2-inch direct pipe laid from the pump to the reservoir.

Almost all of the fences on the station farm were rebuilt during the past fiscal year. The posts, of native timbers, were badly rotted and the woven-wire fencing was being twisted and ruined. New fence posts were obtained from forests near the station and from the Cotot stock farm. Past experience has served to show, however, that the native-timber posts, commonly used, last only about 2 years. To overcome the necessity of replacing fence posts, the station commenced to use reinforced concrete posts during the past year. Concrete posts cost about 40 cents each, and this low cost, combined with their proved durability, makes them especially desirable. About 100 posts were made, and as the wooden posts in the permanent lines of fence rot out they will be replaced gradually by concrete ones.

During the year 3 new pasture lots were provided. A hog pasture, embracing 2 lots and containing about 3 acres of productive, well-drained soil, was fenced with galvanized woven-wire fencing on posts set 8 feet apart. The lots will be planted to Para grass and annual pasture crops. A goat pasture of 2 lots was inclosed on high, well-drained timberland, which has proved satisfactory from every standpoint. The third pasture was fenced for the station mares.

THE COTOT STOCK FARM.

As was briefly noted in the last annual report of the station, near the end of the fiscal year 1914 a stock farm was purchased in the district of Cotot. This farm is located about 10 miles, by wagon and trail, south and east of this station. The long distance, combined with the generally poor condition of the road to Cotot, made the transportation of material for needed improvements difficult.

The first improvement undertaken was the inclosing of a pasture of about 150 acres of native grasses and timber. Woven-wire fence, 42 inches in height, with two strands of barbed wire on top, was fastened to native timber posts deeply set in the soil. About half of the fenced area is lowland, covered with timber and underbrush, and the other half is medium lowland, growing excellent native grass. The water supply is excellent, there being two ever-flowing streams running through the pasture. It is generally considered in Guam that the lowland pastures are most valuable in the dry season in normal years, while for the wet season the higher lands are preferable. But though the pasture at Cotot compares favorably with the best native pastures of Guam, yet it has proved far from satisfactory during the past season, which was characterized by a drought of exceptional duration and severity.

Fifteen native cows and one of the station's pure-bred bulls, Harry Gray, were sent to Cotot December 29, 1914. Some of the cows, especially those with young calves, are in poor condition at this time, and the others have done only fairly well. The young bull, as the report of the animal husbandman and veterinarian shows in detail (see p. 28), did very poorly, and it became necessary to bring him back to the station on February 13, 1915. By the end of the fiscal year the bull had regained about a third of the 145 pounds lost and he was returned to Cotot on June 30. It was doubtless true that the principal cause of the bull's loss in weight came from tick infestation and not necessarily from the native pasturage alone. The bull is now being kept relatively free from ticks, and grain, in addition to the native pasturage, is provided for him.

The experience of the past season with the native grasses and underbrush for pasturing live stock at Cotot has clearly shown the necessity of substituting for them the proved introduced pasture grasses, such as *Paspalum dilatatum* and Para (*Panicum molle*). With this end in view, sufficient land has been cleared for planting about one-half acre of each grass during the coming wet season to provide grass roots for use in planting larger areas in the wet season of 1916.

Near the end of the fiscal year a three-room house was constructed for the foreman.

The station is fortunate in obtaining Mr. Barbour for foreman of the Cotot farm. His training at the station for some three years served to give him a good idea of the methods of handling live stock, and he should obtain satisfactory results from experimental work at Cotot during the coming year. The major portion of the station's study of the effect of ticks upon native cattle, as well as orchard and vegetable experiments, will be carried on there.

It is planned to use Cotot not only as a place for the surplus live stock of this station but also as a situation for testing, under such conditions as any native may have, methods of handling live stock and growing crops. This will be in addition to the experimental work conducted.

From the standpoint of soil, the new farm offers advantages over the home station, where the heavy soils and poor drainage make the production of citrus fruits extremely difficult. At Cotot there are lighter soils, and it seems a fair conclusion that citrus fruits will do well. Cotot will also furnish soil types for testing trees, field crops, etc.

HORTICULTURAL WORK.

In the horticultural experiments, work on methods of mango propagation and vegetable growing has been continued without any further important data being noted. As has been stated in former reports of this station, these two experiments have been conducted more as demonstrations to the natives than for the experimental data obtained. However, this work will be placed more upon an experimental basis in the hope of establishing several points that need investigation.

In the shading experiment conducted for the purpose of reducing, if possible, the pungency of peppers during the dry season, the results of the past season's work go to show that the shading has little, if any, effect upon the pungency. This experiment, however, gave valuable information as to the effect of shading in increasing the yield and improving the quality of peppers. For this reason, during the next dry season not only will the work with peppers be continued, but the effect of shading on other vegetable crops will also be studied.

The past wet season brought out strongly the fact that the heavy soil and consequent poor drainage of the regular garden plats made it possible to grow but few vegetables during the months of August, September, October, and a part of November. Therefore, about June 1 of this year, a new wet-weather garden was cleared and prepared for planting. The past dry season held so long that the new garden had not been planted at the end of the fiscal year. The comparative yields of the sidehill garden and the present lowland garden should give valuable data for Guam vegetable growers.

SEED AND PLANT INTRODUCTION

The plant introduction work has received considerable attention because it is fully realized that Guam produces neither the kinds nor the amounts of the different tropical fruits and vegetables that it should. An orchard has been laid out on the site of a former orchard at the station. The situation selected is considered desirable, and with good care given to the trees this station should be able successfully to add many tropical fruits and vegetables to the list now grown in Guam. Most of the seeds and trees introduced were received near the end of the fiscal year, and few of them had been planted in their permanent situations at the end of the year. Through the cooperation of the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture, the following plants were introduced:

Plants imported.

Name of plant.	Number of plants.	Name of plant.	Number of plants.
<i>Aleurites</i> sp.....	6	<i>Diospyros montana</i>	4
<i>Amygdalus davidiana</i>	5	<i>Elephantorrhiza elephantina</i>	25
<i>Aralia cordata</i>	5	<i>Feijoa sellowiana</i>	6
<i>Bambusa</i> sp.....	5	<i>Greigia</i> sp.....	3
<i>Baryxylum inerme</i>	5	<i>Myrciaria edulis</i>	4
<i>Campanomanesia</i> sp.....	1	<i>Myrciaria cauliflora</i>	5
<i>Carissa grandiflora</i>	5	<i>Passiflora ligularis</i>	5
<i>Citrus</i> spp. (6 species).....	26	<i>Passiflora maliformis</i>	6
<i>Citrus hystrix</i>	3	Pecan, Van Deman.....	6
<i>Clausena lansium</i>	5	<i>Phyllostachys</i> sp.....	5
<i>Diospyros kaki</i>	1	<i>Ziziphus jujuba</i>	6

In addition to the plants mentioned above, the following varieties of seeds were introduced during the year:

Seeds imported.

Name of plant.	Quantity.	Source.
Alfalfa, common.....pounds..	5	Germain Seed Co., Los Angeles, Cal.
Beans, soy.....bags..	2	J. B. Thompson, Nagasaki, Japan.
Beans, velvet.....pounds..	2	Morse & Co., San Francisco, Cal.
<i>Botor tetragonoloba</i>packets..	3	Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry.
Chickpeas, 9 varieties and strains.....bags..	16	Do.
Cotton:		
Caravonica "wool".....lb. g..	1	Hawaii Experiment Station.
Cleveland.....do..	1	Alabama Experiment Station.
Columbia.....do..	1	Hawaii Experiment Station.
Cook.....do..	1	Alabama Experiment Station.
Covington-Toole.....do..	1	Do.
Egyptian Gila.....do..	1	Sacaton, Ariz. ¹
Egyptian Pima.....do..	1	Do. ¹
Egyptian Yuma.....do..	1	Do. ¹
Do.....do..		Texas Experiment Station
Hartsville.....		Do.
Improved Blue.....		Do.
Long Star.....		Do.
Mebane Trium.....		Do.
Roundnose.....		Do.
Seabrook, 3.....		Do.

¹Through the cooperation of the Bureau of Plant Industry, United States Department of Agriculture.

Seeds imported—Continued.

Name of plant.	Quantity.	Source.
Cowpeas, Whippoorwill.....pounds..	5	Morse & Co., San Francisco, Cal.
Feterita.....packages..	2	Office of Cereal Investigations, Bureau of Plant Industry.
Grasses:		
Brome.....pounds..	2	Morse & Co., San Francisco, Cal.
Orchard.....do....	4	Do.
Redtop.....do....	2	Do.
Sheep fescue.....do....	2	Do.
Muskmelon, 27 varieties.....packets..	80	Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry.
Rice:		
Ceylon No. 19.....package..	1	Hawaii Experiment Station.
Chinese, 2 varieties.....packages..	2	Do.
Japanese, 3 varieties.....do....	3	Do.
Hawaiian.....package..	1	Do.
Watermelon, 8 varieties.....packets..	24	Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry.
Watermelon, 2 varieties.....do....	2	Germain Seed Co., Los Angeles, Cal.

SEED AND PLANT DISTRIBUTION.

The demand upon the station for fruit and ornamental trees, garden and farm crop seeds, and grass roots has shown a marked increase, and, except in the case of the grass roots, has greatly exceeded the supplies available. A few illustrations will serve to emphasize the increase in this phase of the station's activities:

Some important seed and plant distributions.

Name of plant.	Quantity distributed.	
	1915	1914
Lima bean, seed.....packets..	610	25
String bean, seed.....do....	1,375	220
Carrot, seed.....do....	477	107
Watermelon, seed.....do....	573	210
Para grass, roots.....sacks..	115	10
<i>Barleria cristata</i>plants..	990	160
Mango.....trees..	202	160

The increase in all other material distributed has been proportionately large where it has been at all possible to meet the demand.

In addition to the seeds and plants noted in the above list, the following kinds have been distributed during the year:

Garden seeds: Cucumber, eggplant, lettuce, muskmelon, okra, pepper, pumpkin, radish, and squash.

Field-crop seeds: Chickpea, cowpea, feterita, kafir, sorghum, and soy bean.

Grass roots: *Paspalum dilatatum*.

Fruits: *Aberia gardnerii*, avocado seedlings, bananas, *Carissa arduina* (*grandiflora*), and papayas.

Ornamentals: *Bauhinia* sp., *Cæsalpinia* sp., *Cestrum nocturnum*, crêpe myrtle, *Gardenia jasminoides*, different varieties of hibiscus, *Prosopis juliflora*, and *Tabernæmontana grandiflora*.

Near the end of the fiscal year, with the advent of plentiful water supplies at the station for irrigating purposes, about 5,000 cuttings and several hundred seeds of ornamental plants were started, and several hundred seeds of mangoes, avocados, and cacao were planted. The station's pineapple and banana fields were extended during the year to provide a larger number of plants for distribution. An area of more than one-half acre has been set aside as a tree nursery in order to provide satisfactory conditions for growing cuttings and plants from the time they are well started until they are sufficiently large to distribute.

The increase in seed and plant distribution comes largely because of the cooperation between the station and the police department of the naval government of the island. It was evident near the beginning of the past fiscal year that the station could distribute considerable quantities of seeds and plants in the different portions of the island, but there was no assurance that the material put out would be planted and cared for properly. The police department has patrolmen in the different localities, and these men take strong interest in improving conditions under their charge. Furthermore, the head of the department, Capt. E. H. Ellis, United States Marine Corps, fully recognizes the need of improving agricultural conditions and of beautifying the island, and the cooperation has largely resulted through his offers of assistance. To Corpl. H. G. Hornbostel, United States Marine Corps, chief forester of Guam, has fallen the immediate supervision of the planting and attention to much of the material from this station, and Mr. Hornbostel deserves much credit for his efforts in this work. The cooperation has resulted in assuring not only the careful planting of the material obtained, but also proper care on the part of the natives of the material planted. As heretofore, a record is kept in the station files of the names of the persons to whom material is distributed, and notes and photographs obtained from time to time are also filed. Plate II shows flowering plants. Para grass and hedge plants (*Barleria cristata*) that were distributed during the dry season at Inarajan, Guam.

LIVE-STOCK WORK.

The breeding experiments with horses, cattle, hogs, goats, and chickens have been continued along the same lines as heretofore. It has been uniformly noted that the station's pure-bred sires bring about a marked improvement in the native live stock even in the first generation, although from the standpoint of hardiness a certain per-

centage of native blood, yet to be determined in the case of each kind of live stock, appears to be desirable. It is hoped that at the end of one more year's work some definite conclusions can be deduced from the breeding experiments.

The effect of inbreeding has become strongly noticeable in the station's hogs and chickens. It is therefore pleasing to note that near the end of this fiscal year arrangements were made for the shipment of hogs, goats, and chickens from the United States to the station early in the coming year.

An effort is being made to increase the usefulness of the station sires in improving the live stock on the island. In this particular it seems necessary to take the sires directly to the different sections of the island rather than to expect the natives to bring their animals to the station for breeding. Relatively few live-stock owners in Guam appreciate the value of live-stock improvement or care greatly whether they breed their stock to "scrub" or pure-bred animals. The station's half-breed Ayrshire bull, John Rhodes, was kept in Agana, Guam, for several months, and about June 20 he was moved from Agana to Merizo, Guam, the maximum number of cows, four per week, as set by this station, having been bred thus far. During the next fiscal year more breeding sires will be available, and they will be sent to different sections of the island.

During the past year the station sold few young animals, and it now has a sufficient number for some experimental investigations. In the case of the hogs, most of the brood sows were getting old, and there were no young sows to replace them. During the next fiscal year almost all of the station's live stock will be serving some experimental end, aside from the breeding investigations. Furthermore, the increase in the number of breeding animals kept will result in a marked increase in the number of young animals the station will have available for distribution to interested ranchers. There have been many requests for improved live stock, and it is doubtful whether the station will be able to meet the demand even with the increased number of breeding animals available.

FARM-CROPS WORK.

CORN EXPERIMENTS.

The prevailing market price for native-grown, dry, shelled corn in Guam during the past year has been about $2\frac{1}{2}$ cents a pound, or \$1.40 per bushel. At that price few growers were unable to market their crop as soon as their corn was sufficiently dry. Guam natives are corn eaters, and ground corn made into tortillas may truly be said to be their "staff of life." Still, corn production per acre is low, 20



FIG. 1.—TYPE OF GUAM CORN USED IN IMPROVEMENT EXPERIMENTS.



FIG. 2.—EGYPTIAN YUMA COTTON.



FIG. 1.—HOGS PASTURING ON COWPEAS.



FIG. 2.—*PASPALUM DILATATUM* DURING DROUGHT.

bushels being a large yield, and the quality of the corn produced in most cases is decidedly inferior. There are several reasons why the native corn crop would not compare with that produced in the Middle Western States of the United States. Climatic conditions, including especially either an overabundance or a scarcity of moisture at critical periods, inferior seed-bed preparation and cultivation, general prevalence of corn insect enemies, and lack of improvement of any description are the chief factors in the production of poor corn in Guam.

The problem of profitably growing corn in Guam is believed to be not impossible of solution, for every modern practice seems to be attended with success. The undesirable moisture distribution may be largely overcome, as has been shown at the station during the past season, by using deeper and better seed-bed preparation, having the plants farther apart in the rows, and practicing more frequent cultivation. The native corn grower makes no attempt to cultivate his soil, his only effort being to keep down weeds. It has been demonstrated at the station that a good 8-inch plow can be drawn by two carabaos, and even though the soil turns up hard and cloddy, a small pulverizer breaks it down in good shape after a shower. Furthermore, the 5-tooth cultivator is effectively used for maintaining a fairly open field and a good dirt mulch. These methods are within the reach of the average grower.

In considering corn improvement in Guam, attention should first be given to the corn now grown. Normally the stalks are relatively low growing, about 5 or 6 feet in height, and most stalks bear two small ears. The shanks are large, and, as with most other crops grown in the Tropics, there is a large amount of foliage. There is no uniformity in size or shape of ear, an outcome of a lack of selection or other improvement. In size the ears would be classed as decidedly small, perhaps averaging 5 inches in length, while in shape there is little taper from butt to tip. Both grain and cob are normally white, showing little variation in color. The space between the kernels on the cob is large, and this, with shallow kernels and large cobs, makes a low percentage of grain to cob.

This station during the past fiscal year started an experiment to improve the native corn, with the idea of distributing improved seed if marked success were attained. In this experiment the principal improvements undertaken are earlier maturity, production of one ear per stalk, and uniformity of crop. The present corn crop matures in about 120 days, and thus both the first crop, planted normally about June 1, and the second crop, planted about November 15, are reduced in yield, the former maturing in too rainy a season, the latter in too dry a period. Also it has been fully demonstrated here that

two ears per stalk give inferior corn. It is believed that the yield per acre will be greatly increased by improved cultural methods, but aside from this no special efforts toward increasing yields will be made at present, as it is desired to first obtain a uniform, one-ear-to-the-stalk, early maturing corn. From the second crop of the past year good ears were selected from plants meeting the requirements, and these were planted June 15 by the ear-to-row method. (Pl. III, fig. 1.)

COTTON EXPERIMENTS.

It is not uncommon to see cotton plants growing wild around the houses of Guam natives. This type is not valued for cotton production, but for ornamental purposes. An examination of the plant indicates that it is probably the so-called tree cotton (*Gossypium arboreum*).

In the southern portion of the island in particular Sea Island cotton (*Gossypium barbadense*) is found growing on different ranches in an apparently wild state. It appears that this plant was introduced into Guam years ago and that an attempt was made to grow cotton extensively, but the labor problem forced those interested in the project to abandon it. Observations as to the production and the quality of fiber of the few plants growing in the above section would indicate the adaptability of Sea Island cotton to Guam, but the data obtained at the station go far to show the inferiority of that type to the Egyptian type under the soil and climatic conditions of the island.

During the past dry season the station tested several cotton varieties, and while most of the cottons did fairly well, it should be mentioned that the seed, except in the case of the Egyptian and the Columbia, a long-staple American Upland, both of which came from Hawaii, was not received from the United States sufficiently early to plant the crop at the most favorable time, about December 1. The following table gives the yields per acre of seed cotton produced by the different varieties:

Yields of types and varieties tested.

Type.	Variety.	Source of seed.	Yield per acre.
			<i>Pounds.</i>
Egyptian.....	Yuma.....	Hawaii.....	1,641
Do.....	Gila.....	Arizona.....	1,024
Do.....	Pima.....	do.....	512
Do.....	Yuma.....	do.....	524
Sea Island.....	Seabrook.....	Florida.....	326
Do.....	Seabrook, Centerville selection.....	do.....	246
Do.....	Seabrook, Rivers selection.....	do.....	307
American Upland.....	Columbia.....	Hawaii.....	588
Do.....	Improved Blue Ribbon.....	South Carolina.....	329
Do.....	Covington-Toole.....	Alabama.....	1,170

The Egyptian and Columbia cotton seed obtained from Hawaii was planted on December 10, 1914, while the seed of the remaining varieties was planted January 8, 1915. Thus, except for the Hawaiian seed, the late planting in a measure, it is believed, accounts for the low yields obtained per acre. It is also well to note that Caravonica cotton, obtained from Hawaii and planted December 8, 1914, had produced very few bolls up to June 30, 1915.

The dry season in Guam is about ideal for the maturing and harvesting of cotton. Where the crop is planted about December 1 the rains of the latter part of the wet season produce the crop, and the maturing season comes at a time when there is little rain or wind. This insures cotton of high market grade, because, except for a small amount of leaf obtained in harvesting, no penalties, unless perhaps on luster and color, can be given. Furthermore, there seems to be little danger of price reductions on any grade because of tinges and stains.

In this connection Lieut. Robert Henderson, of the United States Navy, commanding the U. S. S. *Supply*, sent a sample of Guam Sea Island cotton to Shanghai, China, and the cotton was reported to be of excellent quality, commanding a high market price. The firm to which the sample was sent wrote expressing a desire to handle the cotton produced in Guam.

There are many acres of land in Guam that can be converted into cotton fields, and if the yield of the Egyptian Yuma during the past season is duplicated upon further trial the possibility of growing that cotton profitably here would be assured. (Pl. III, fig. 2.)

On June 22 and 23, 1915, new plantings of the different varieties were made in order to study the effects of the wet season on growth and production. Furthermore, on June 8, 1915, old plants of the Egyptian and other cotton types on small areas were cut down to the ground in order to observe the growth and production of crops obtained from ratooning.

FORAGE-CROP STUDIES.

PARA GRASS (*Panicum molle*).

The past dry season has again emphasized the value of Para grass as a soiling crop for Guam. Practically all of the station pastures failed during the latter part of April and the month of May, while all were useless through June, 2½ acres of Para grass alone holding out through the season. Under the exceptionally dry conditions the grass grew about 3 feet high and was fairly thick, although it was cut about once every 5 weeks during that period. It has been noted, however, in examining the fields that the stand is gradually becoming thinner and that the native inferior grasses are occupying the

vacant places. Consequently during the coming wet season a study will be made of the effects of fertilizing and plowing upon increasing both the stand and the production per acre.

FETERITA AND KAFIR.

Feterita and kafir were grown on about 1 acre of low-lying clay soil. These crops were planted on November 12, 1914, in rows 3 feet apart with 30 inches between the hills in the rows. Cultivation about every two weeks was given with a 5-tooth cultivator. The feterita was ripe and ready for harvesting February 4, 1915, while the kafir heads were not matured until eight days later. After the crops had been harvested, a second crop (ratoon) came on and matured small heads. Heads were selected from the most desirable plants of the first crop for furnishing seed for station use and for distribution. Both crops of fodder were fed to cattle and horses without detrimental results.

A further test was undertaken with these crops to determine the effect of planting in the dry season. Both crops were planted January 8, 1915. Feterita reached maturity on March 23, 1915, and the kafir on March 28, 1915. The heads in this case were well filled, but the forage production was considerably less than from the crop planted on November 13, 1914. It is interesting to note that the time of planting had a marked effect upon the time required for maturity, the first crop of feterita requiring 84 days to mature and the second crop only 74.

The qualities of feterita generally considered undesirable, as observed in the southwestern portion of the United States, namely, side branching, suckering, and shattering, were especially strong in the first crop grown at the Guam station. In the later crop, shattering was pronounced, but there was little side branching, or suckering. The kafir did not prove as promising for the dry season here as did feterita. This was especially true as regards attack by the principal insect enemies of these crops, caterpillars of two common moths, probably *Cryptoblastes* sp. and *Batrachedra* sp. Few heads of feterita were attacked, while most of the heads of the kafir were affected. The grain sorghum crops make excellent chicken feed, which is badly needed in Guam.

COWPEAS AND SOY BEANS.

As will be noted under the heading, "Pasture crops for hogs" (p. 22), cowpeas and soy beans grow well in Guam. They are valuable additions to the list of crops that can be successfully grown. Cowpeas would seem best suited for pasture purposes. Soy beans, however, will doubtless become an important food crop of the natives.

Much of the soy-bean seed distributed went to persons who intended to grow the crop for eating purposes.

The increased interest of the natives in forage crops augurs well. The coming wet season will find many acres of low, unused land producing Para and Paspalum grasses and annual forage crops of different kinds.

SOIL TESTS WITH PASPALUM DILATATUM.

The experiment for determining the adaptability to different soils of the valuable introduced pasture grass, *Paspalum dilatatum*, was greatly extended during the year (Pl. IV, fig. 2.) Some of the grass was planted on poorly drained, exceptionally heavy clays, some on medium high clay soils, and still other on hillsides where outcropping rock and cascajo formed the principal part of the surface. Although the past dry season lasted at least a month longer than usual and much of the grass to all outward appearances was dead, yet the few light showers that came near the end of the year caused the grass tufts to again become green on all soil types.

While the grass planting of the past fiscal year was not finished until about October 1, some deductions may safely be drawn from the experiment. Paspalum has a wide range of usefulness and gives much more pasture, even on the poorer, rocky soils, than the native grasses give. It is true that during about three months of an extremely dry season Paspalum did not give much pasture, but at that time the native pastures were so dried that they could be burned. The principal good coming from Paspalum on any soil is the large amount of pasture that it gives during nine months of the year. On the better soils it will support from two to three times as many cattle as the native grasses. There is little doubt that a good stand can be obtained on the poorest soils or on the undrained soils if the roots are planted close together. In this particular it should be noted that on the undrained soils Para grass appears to give the largest yields both for pasture and for soiling purposes. All evidence goes to show that on the poorer soils extreme care is necessary, since too heavy pasturing will destroy the stand.

Some interesting data were obtained on the cost of planting Paspalum. Considering all expenses, including plowing and otherwise preparing the soil, hauling and setting the roots, the cost of planting per acre was about \$16. This cost covers plowing at \$7.50 per acre (the lowest price that the station has ever paid), disking the fields twice at \$1, and digging out, hauling, and planting the roots at \$7.50 per acre. While the amount seems large, the increased amount of pasture now furnished by the station's Paspalum fields is strong evidence that it is a paying proposition.

PASTURE CROPS FOR HOGS.

The experimental data obtained by the station have clearly shown that profitable hog production in Guam depends especially upon the use of pastures for growing and maturing hogs. The cost of imported feeds would prohibit their use for anything except finishing hogs. Experience has also shown that the land used for pastures must be well drained, else parasitic diseases, especially during the wet seasons, become disastrous.

With the object of testing in a preliminary way different pasture crops for hogs, small acreages of cowpeas and soy beans were planted last December. The cowpeas had reached sufficient maturity, namely, the pods were well formed but not ripe, at the end of 78 days to permit the hogs being turned into the field of 0.34 acre. The soy beans required only 62 days to have pods well formed, with foliage still green and succulent, when the hogs were turned into the field of 0.20 acre. The hogs ate the cowpea vines and pods greedily, but, though the leaves of the soy beans were eaten at once, the pods were not touched for several days, and they were never completely utilized. These preliminary tests showed conclusively the superiority of the cowpea over the soy bean for hog pasture under Guam conditions. (Pl. IV, fig. 1.) While the hogs ate the cowpea vines well down to the ground, the stalks commenced to grow again and would have provided a good second crop of pasture had the dry season not been of such great intensity. Everything points to the fact that during the wet seasons at least two crops of pasturage can be obtained from one seeding of cowpeas.

Half an acre of Para grass was also given a preliminary test as a hog pasture. Six sows and one boar were turned into the field, and they kept in good flesh throughout most of the extreme dry season. The Para grass proved excellent, although the preliminary test showed that this grass should not be pastured too heavily, and furthermore, that it should be given rest periods of at least two out of every five weeks in which to recuperate.

The new hog pasture is now composed of four lots, two of which will be planted to Para grass during the coming rainy season, leaving the other lots for cowpeas, soy beans, and other annual pasture crops.

Near the end of the fiscal year a project was undertaken to determine definitely the value for hog maintenance and production under Guam conditions of cowpeas, soy beans, peanuts, Para grass, and other valuable hog-pasture crops that may be introduced. The peanuts have already been planted, and the cowpeas, soy beans, and Para grass will be put in just as soon as sufficient moisture comes.

ACKNOWLEDGMENT.

During the past fiscal year the cooperation between this station and the naval government of Guam has been gratifying. The governor of Guam, Capt. W. J. Maxwell, of the United States Navy, is especially interested in improving agricultural conditions on the island and has encouraged every effort of the station. Mr. R. C. Gibson, in charge of the Government stables, has aided this station in every possible way in its work of live-stock improvement.

REPORT OF THE ANIMAL HUSBANDMAN AND VETERINARIAN.

By L. B. BARBER.

BREEDING EXPERIMENTS.

The breeding work during the past fiscal year has proceeded along the same lines as in former years. With but one exception, that of the old Berkshire sow, the station has suffered no losses among the pure-bred stock.

The horse-breeding work showed an increase through the birth of two Morgan fillies.

Guam Island Rose gave birth to a heifer¹ calf January 28, 1915, the first calf of the second generation of Ayrshires on the island. The Ayrshire-native heifer, Maria Gray, gave birth to a bull calf May 18, 1915, the first three-quarter blood Ayrshire calf born in Guam. Harry Gray, the pure-bred Ayrshire bull born at the station, is kept for breeding at Cotot. John Gray, the imported Ayrshire bull, is at the present time in excellent condition and is being retained at the station for breeding work. John Rhodes, the Ayrshire-native bull, has been sent to Merizo, a village located on the southern end of the island, for breeding purposes. Although Willowmoor Red Rose, the imported Ayrshire cow, has done poorly throughout the year, on June 30, 1915, her general condition was much improved.

The goat-breeding work has been especially gratifying. The Japanese native buck standing at the head of the herd is a large, vigorous animal with a splendid conformation and has proved to be an excellent sire. Sixteen kids have been born to nine does, an increase representing but one breeding. Most of these does are again showing signs of advanced pregnancy. The old imported Japanese doe and a young Japanese native doe are due to kid in July of the coming year. These goats have occupied a pasture about 3 acres in size consisting of rough hill land, part of which is densely covered with brush, the remaining part growing coarse native grasses. No extra feed or attention has been given the goats at any time. The

general nature of the country and the cheapness of production, together with the apparent health and hardiness of the goats, speak well for the future of this industry.

PIG-FEEDING EXPERIMENT.

On April 28, 1915, a pig-feeding experiment was commenced with the object of determining the comparative feeding value of a ration composed of native feed and that of a ration consisting of imported feed. The eight pigs used in the experiment were of the Berkshire native cross, six months of age, but somewhat undersized although in a healthy condition. Six sows and 2 barrows were used, 3 sows and 1 barrow being contained in each lot. (See Pl. V.) The experiment was run for 64 days and each lot received 10 pounds of Para grass daily. The kinds of feed, cost of feed and labor, gains, and cost per pound of gain are shown in the following summary:

Feed consumed, cost, and labor, lot No. 1:

Breadfruit (at one-half cent per pound), 18 pounds	
daily-----pounds--	1, 152
Coconut, grated (at 1 cent per pound), 3 pounds	
daily-----pounds--	192
Labor, 6 cents per day-----	\$3. 84

Feed consumed, cost, and labor, lot No. 2:

Corn chop (at $2\frac{1}{4}$ cents per pound), 4 pounds	
daily-----pounds--	256
Wheat shorts (at $1\frac{3}{4}$ cents per pound), 4 pounds	
daily-----pounds--	256
Labor, 4 cents per day-----	\$2. 56

Weights and gains, lot No. 1:

Weight on Apr. 28, 1915-----pounds--	117
Weight on June 30, 1915-----do----	230
Gain in 64 days-----do----	113
Average gain per pig-----do----	28. 25
Average daily gain per pig-----do----	. 44
Cost to produce 113 pounds of gain-----	\$11. 52
Cost per pound of gain-----	. 101

Weights and gains, lot No. 2:

Weight on Apr. 28, 1915-----pounds--	108. 1
Weight on June 30, 1915-----do----	242. 5
Gain in 64 days-----do----	134. 4
Average gain per pig-----do----	33. 6
Average daily gain per pig-----do----	. 52
Cost to produce 134.4 pounds of gain-----	\$12. 80
Cost per pound of gain-----	. 095

The weekly gains of the individual pigs in the experiment are shown in the table following.

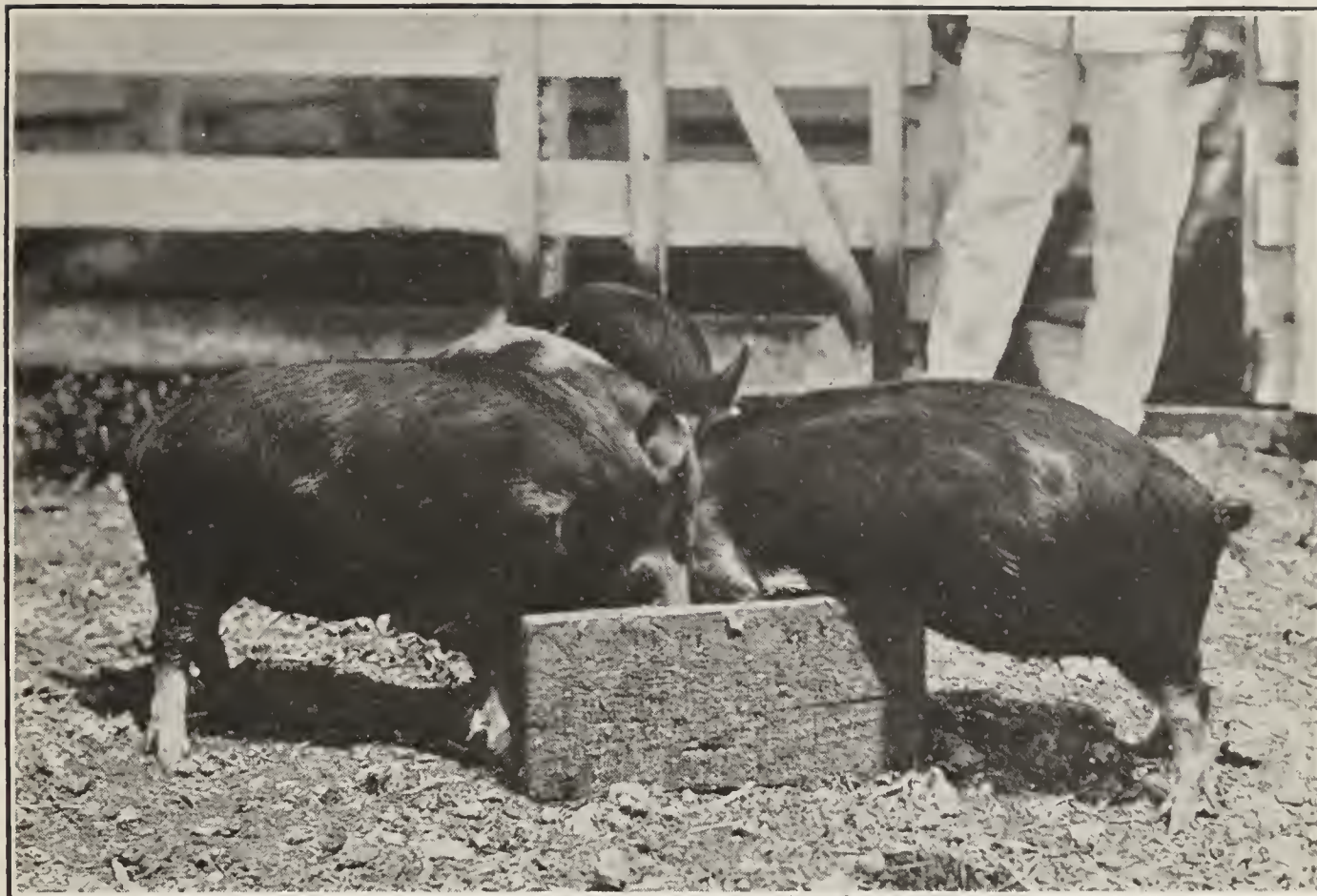


FIG. 1.—PIGS FED ON NATIVE FEEDS.



FIG. 2.—PIGS FED ON IMPORTED FEEDS.



FIG. 1.—EFFECT OF TICK INFESTATION; FANNIE LOST 167 POUNDS IN WEIGHT IN 6 MONTHS.



FIG. 2.—EFFECT OF TICK INFESTATION; HARRY GRAY LOST 145 POUNDS IN WEIGHT IN 45 DAYS.

Table showing weekly weights of pigs.

	Apr. 28.	May 5.	May 12.	May 19.	May 26.	June 2.	June 9.	June 16.	June 23.	June 30.
Lot No. 1:	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Pig No. 75.....	22	25	29	30	31	34	36.5	40	43	47
Pig No. 67.....	30	32	36	38	39.2	43.5	45.5	49	53	60
Pig No. 68.....	34	37	41	41.5	43.6	47	49.5	51.5	56	58
Pig No. 69.....	31	35	37	37	43.2	49	51.5	53.5	60	65
Average weekly weight...	29.25	32.25	35.75	36.62	39.25	43.37	45.75	48.5	53	57.5
Lot No. 2:										
Pig No. 76.....	23	25	29.5	33	36	40	42	44.5	47.5	52
Pig No. 72.....	26.5	28	32	36	40.2	43	45	49	51	54.5
Pig No. 73.....	27.2	29.5	36.5	40	45	50.5	55	58.5	61	67
Pig No. 74.....	31.4	32	37	42	47.2	52.5	57.5	60.5	66	69
Average weekly weight...	27.02	28.62	33.75	37.75	42.1	46.5	49.88	53.12	56.37	60.62

With the exception of one week, during which the pigs in lot No. 1 were being fed immature breadfruit, the pigs in both lots consumed their feed well. Heretofore no market price has ever been placed on breadfruit in Guam. The cost to a native in producing the 113 pounds of gain would be materially lessened. The price paid for the imported feeds is almost prohibitive to anyone in Guam. The pigs in lot No. 1 were virtually on full feed while the pigs in lot No. 2 were on little better than a maintenance ration. Conclusions will be reserved until the close of the experiment.

LIVE STOCK DISEASE INVESTIGATIONS.

CATTLE DISEASES.

TICK FEVER.

In identifying the tick which infests the cattle of Guam, Dr. B. H. Ransom, Chief of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture, stated: "The ticks from cattle are not distinguishable from *Margaropus caudatus*, sometimes regarded as a variety of the common cattle tick under the name *Margaropus annulatus caudatus*, and probably are this species. *M. caudatus* was described from horses in Japan, but its occurrence on cattle in Guam would not be at all unlikely."

The station has been unable to determine any difference between the ticks infesting cattle and those infesting horses, carabaos, goats, and deer. The effect of these ticks on the cattle of Guam constitutes by far the most serious obstacle in the way of the cattle industry. The ticks may be found on the cattle throughout the year. It seems, however, that they are more abundant during the dry season. The serious infestation takes place during the dry season. This may be explained, at least in part, by the fact that the

cattle at that time of the year are usually in poor condition, due to the absence of proper food and in many cases a shortage of fresh water. A movement is now on foot to convert some of the old rice fields into fields of Para grass to relieve this situation.

Studies for determining the length of time required for the engorged female tick to lay, for the eggs to hatch, and for the seed tick to develop into a mature female after being attached to its host do not show that the Guam tick differs essentially in its life history from that of *Margaropus annulatus*.

The effect of tick infestation on native cattle is in itself worthy of consideration. An occasional excellent cart animal, which is fairly well cared for and kept comparatively free of ticks, only demonstrates what can be expected in cattle raising in Guam. Ticks are, however, so widely spread on the island that few calves succeed in avoiding serious infestations. This causes a decided check in the growth and normal development of the calf and results in an undersized and undesirable animal.

Native cattle badly infested with ticks show the following general conditions: Body greatly emaciated, visible mucous membranes anemic, and superficial lymph glands enlarged. The afflicted animal will tremble violently when exposed to heavy rains. A disease which is spoken of by the people of Guam as the "trembling disease" probably is a result of tick infestation, judging from the description of the symptoms and general conditions.

The loss to cattle owners due to these ticks would be difficult to estimate. The presence of thousands of ticks on an animal and the irritation which they set up result in weak, undersized cattle, influence the regularity of their breeding, and materially affect them as milk producers.

A rancher in the vicinity of Merizo has for years practiced selection in making up his herd of breeding cattle, and has, through native methods, endeavored to keep down tick infestation. The result is that he now maintains a herd of cattle superior to any other herd which has been observed in Guam. A great percentage of the cattle live in the interior of the island and never receive any special care or attention of any kind. This has produced an undersized, degenerate breed, not averaging in weight over 400 pounds after maturity. Tick infestation and inbreeding are probably largely responsible for this condition.

The effect of tick infestation on imported cattle is much more striking. Certain conclusions may be drawn from a general survey of the temperature chart of Willowmoor Red Rose during the past fiscal year (fig. 1). The temperature chart fluctuates almost from day to day, the limits of fluctuation throughout the year being between 99° and 108° F. This cow is infested with ticks about half

the time, the degree of infestation varying from a few ticks to many hundreds. It has been necessary to pasture this cow in various places on the station lands, and although hand picking of ticks has been practiced and repeated applications of cottonseed oil and kerosene have been made she frequently becomes reinfested. The presence of ticks in large numbers on the cow always causes a rise in temperature. It appears that establishment of immunity would be difficult and unreliable. Instead of an immunity being established the disease seems to assume a chronic form. Death may occur at any time, or the animal may continue to live in an emaciated condition, with anemic mucous membrane, somewhat impaired appetite, a jugular pulse, and almost constant diarrhea. It is believed that imported cattle, if allowed to become reinfested with ticks from time to time, will die either of an acute or chronic form of the disease, or continue to live indefinitely, displaying the above symptoms.

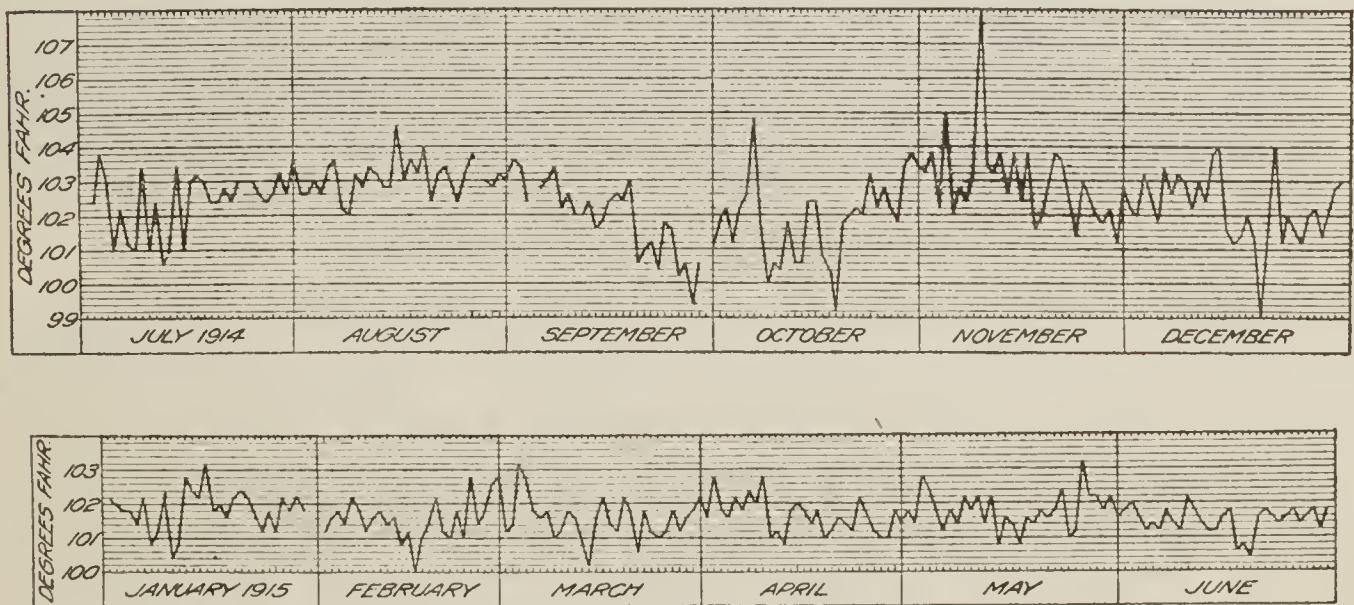


FIG. 1.—Temperature chart of Willowmoor Red Rose.

John Gray, the imported Ayrshire bull, has suffered several severe attacks of fever due to the ticks. Prompt removal of the ticks and good care at the time have left him in excellent condition. This bull in the past year has been infested with ticks but once, from the latter part of December, 1914, to an early date in January, 1915. At all other times he has been tick free. A study of the temperature chart (fig. 2) will show several slight drops and rises in his temperature which were due to exposure to the sun or to chilling showers for too long a period. With the exception of these slight variations and that during his illness in December, his temperature has been practically normal. Although this bull has been tick infested several times and has suffered severe attacks of fever varying from 5 to 10 days in duration, the station feels that to send him to the stock farm at Cotot and allow him to run free, with no attention paid to tick infestation, would result in the loss of the animal. The effect of tick

infestation on Fannie, one of the station cows, which lost 167 pounds in six months, is shown in Plate VI, figure 1.

The pure-bred Ayrshire bull, Harry Gray, bred at the Guam Experiment Station, was sent to Cotot for breeding purposes December 29, 1914, weighing at that time 715 pounds. As was noted in the discussion of the Cotot stock farm, the pasture was as valuable as could be obtained in Guam. The bull was allowed to run free in

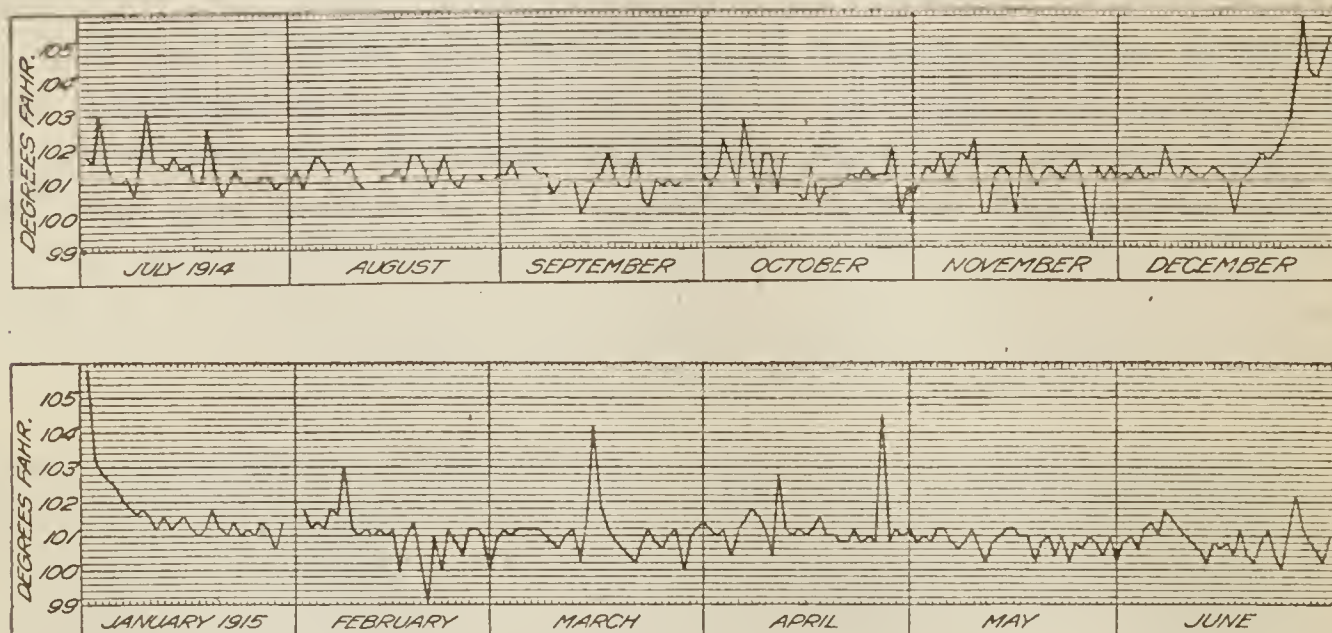


FIG. 2.—Temperature chart of John Gray.

the pasture with the cows until February 13, 1915. Although he was infested with ticks from the start, it was not until that time that the effect of tick infestation became especially serious (fig. 3). When returned to the station on February 13 he weighed 570 pounds and presented the typical symptoms later described in full (Pl. VI, fig. 2). Through a complete riddance of all ticks, the administration of antifebrile agents, and intestinal antiseptics, together with

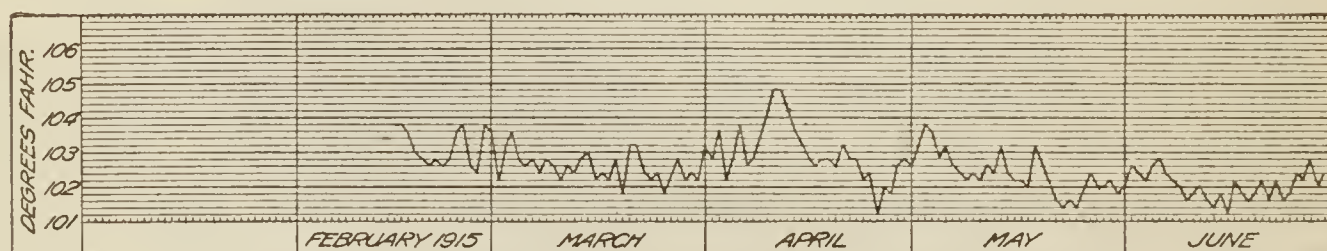


FIG. 3.—Temperature chart of Harry Gray.

proper feed and general good care, he has slowly regained in part his normal condition, weighing 618 pounds on June 30, 1915.

Several examinations of the blood of the Ayrshire cow during the periods of high fever showed the presence of a protozoan. This parasite is smaller than the *Piroplasma bigeminum* and is round, oval, or rod-shaped. Usually but one protozoan is found in a blood cell. Thus far the blood of native cattle has been found free from the parasites.

The body temperature during an attack of fever will vary between 104° and 109° F. The animal shows great depression, dullness, pain, and stupor, and is often noticed resting nose in tie chain in a peculiar manner. A slight edema occurs in the submaxillary region. A rough, scaly, and mangy appearance of neck and shoulders is sometimes present, a condition furnishing an excellent hiding place for ticks. The body becomes emaciated and debilitated. The appetite is impaired but seldom wholly lost. The mucous membranes of the eyes and of the mouth are pale and anemic. Rumination is irregular. In acute attacks, the eyes are bright and feverish, though later they may appear dull and sunken, a profuse watery discharge affecting them. Salivation is sometimes present. Feces in the first stages are glazed and often streaked with blood, and in later stages a severe diarrhea is present, the feces being watery, black, and very foul smelling. The superficial lymph glands are noticeably enlarged. The pulse varies between 70 and 110 beats per minute, and in severe cases a jugular pulse is always present. Breathing is labored, with respirations between 25 and 35 per minute. Abnormal murmurs are often present. The gait is weak and uncertain, noticeably so in the hind quarters. In walking, each hind foot is carried to the opposite side before it is placed on the ground, the feet often interfering with each other and causing stumbling. In some cases the feet are extremely tender, and the animal frequently shifts the weight from one foot to the other. The mere weight of a hand over the loins will cause a sinking of the back. The extremely weakened condition of the hind quarters often makes it difficult for the animal to regain a standing position. The condition of the urine known as hemoglobinuria has not been present in any case.

A post-mortem examination of an animal dying of the chronic form of the disease disclosed the following lesions: Body emaciated; mucous membranes anemic; blood pale and watery; lymph glands swollen and hemorrhagic; liquid effusions in the pleural cavity; mucous membranes of the large intestines congested with necrotic areas; spleen slightly enlarged, softened, and somewhat engorged; liver enlarged, yellowish, mottled, and showing fatty degenerative changes; gall bladder distended and filled with a semifluid containing yellow flakes and mucus; bile ducts greatly distended and filled with a hard, flaky substance; heart pale and showing degenerative changes; kidneys slightly congested; and urine practically normal. Although no flukes were present in this case, the condition of the liver, together with the contents of the bile ducts, was similar to those found commonly in the fluke-infested livers of native animals.

In considering the eradication of the tick in Guam it is well first to fully appreciate the conditions as they exist here. The surface of

the island is rough and uneven. The hills are but poorly covered with grass, while the lower ground is usually densely wooded. The villages and most of the ranches are located close to the seashore, leaving a great portion of the interior of the island in its wild, natural state. Comparatively few fenced pastures are to be found in Guam. Practically all the cattle that are not running in more or less of a wild state in the interior of the island are used as cart animals, traveling from village to village and from ranch to ranch. The constant use of cattle for carting would make it exceedingly difficult to maintain and enforce a quarantine. If the eradication of the ticks were attempted, not only the cattle would have to be taken into account, but the horses, carabao, goats, and deer as well.

The station in the past has practiced hand picking, together with the oil and kerosene treatment, which is unsatisfactory in several essentials. Because of ticky animals on and around the station grounds the animals being freed of ticks frequently become reinfested. A thorough application of oil creates a rise in temperature and always seriously affects the general condition, while the hand application of oil is seldom so thorough as to rid the animal of all ticks. The station is planning during the coming year the use of an arsenical dip in the eradication of ticks by treating the stock at regular intervals.

The method employed by the natives in freeing the cattle of ticks is by standing the infested animal in the sea for an hour or more and thoroughly saturating the body with salt water by means of a coconut husk. The skin of the animal is then scraped with a machete to remove the ticks, after which the juice of some two or three dozen lemons is rubbed well into the skin. This treatment, if repeated two or three times at 6 to 8 day intervals, proves fairly effective.

LIVER FLUKES (*Fasciola hepatica*).

The disease commonly known as liver rot has been found affecting cattle, hogs, and goats in Guam. A post-mortem examination of 32 beef carcasses at the city market in Agana showed 26 livers infested with flukes, 4 livers bearing evidences of former fluke infestation, and 2 normal livers; and of 14 hog carcasses examined, 9 livers were infested with flukes, 2 showed the effects of flukes, and 3 were normal.

The fluke is a small leaflike parasite with thin edges, dark brown or chocolate in color, about 1 inch in length and three-fourths inch in width. The parasites will exhibit contractile movements only for a short time after being removed from the liver; they are hermaphroditic in nature, each animal being capable of producing from 3,000 to 4,000 eggs. The eggs, passing from the intestines of the

host along with the fecal matter, must come in direct contact with fresh water in order to hatch. The first stage of the life cycle is an egg, hatching into a ciliated embryo, which if it succeeds in finding its way to a fresh-water snail of a suitable species, undergoes in this host several changes, finally resulting in what are known as cercariae. The cercaria escapes from the snail, attaches itself to near-by vegetation, becomes encysted, and awaits being taken into the digestive system of its final host.

In certain hogs and goats examined the flukes were found in the lungs as well as in the liver. A microscopic examination of the feces of eight sows showed six to be infested with flukes. The sows were moved to a pasture on high ground, special attention being paid to their drinking water. They were given nourishing food and a laxative with a free mixture of salt. Although these sows regained their normal appearance, the effect upon their litters of pigs was very marked. Thirty per cent of the pigs farrowed were stillborn, while those born alive failed to develop in a normal manner, being, as a whole, weak and emaciated. The separation and expulsion of the fetal membranes from the sows was slow and imperfect, tending toward retention in almost every case. Four out of five goats examined were found to be infested with flukes. These goats were treated in a manner similar to the sows. Two of the goats died, but the remaining two eventually recovered after having aborted their young.

The following symptoms were manifested by a native cow badly infested with ticks and liver flukes: Watery discharge from the eyes, appetite impaired, coat staring, mucous membranes pale and anemic, general attitude dull and listless, gait uncertain, lymph glands swollen, feces at first blood-stained with subsequent diarrhea, breathing labored, heart action weak with a jugular pulse.

A post-mortem examination showed that the hepatic lymph glands were dark and congested, the liver enlarged and presenting on its surface nodular elevations. The nodules proved to be dilatations of the bile ducts and contained either a hard, gritty substance in the form of red or yellowish flakes, or a dark brown or chocolate-colored semifluid holding in suspension shreds of liver tissue. Flukes were found throughout the bile ducts. The gall bladder was distended and filled with a thick, flocculent bile. The spleen was slightly enlarged and somewhat engorged with blood. To say exactly which symptoms were produced by the ticks and which by the flukes is rather difficult. However, the badly diseased condition of the liver caused by the flukes is an important factor and is perhaps largely responsible for the weak heart action and jugular pulse, because of the serious disturbance to the hepatic circulation. Livers which have harbored flukes present the following appearance: The organ is

atrophied and in a cirrhotic condition, with the surface showing many scars; the walls of the bile ducts are thickened and these vessels contain in varying amounts the hard, gritty substance; an excessive growth of connective tissue is found throughout the liver.

The following effects of flukes on animals were observed: Of the 32 cattle examined at the Agana market, all were in fair butchering condition. The livers of some, however, were almost totally destroyed, only a small area remaining normal, this area appearing, however, to function sufficiently to keep the animal in a fairly healthy condition. It is believed that few, if any, cattle succumb as a direct result of fluke infestation. The fluke undoubtedly materially checks the growth and influences to a considerable degree the normal development of a young animal. The effect of flukes on goats and swine, but more especially on goats, appears to be much more serious, and if the conditions are allowed to remain uncorrected, they will eventually result in a high percentage of fatalities. Taking into consideration the life history of the parasite and also the fact that a large percentage of the animals are pastured in low, swampy places, the prevalence of flukes among the different animals of the island is largely explained.

For the prevention of losses by flukes the following suggestions are offered: Draining the swamps and thus depriving the snails of fresh water in order to exterminate them; sprinkling salt and lime over the swamps to destroy the snails and embryos; keeping a swampy pasture free from animals to eventually bring about the death of all the embryos; introducing frogs and toads, of which the island is at the present time entirely void, to assist in the eradication of the snails; and thorough burning of the pasture to destroy the encysted embryos. Manure from the infested animals should be treated with lime and salt and placed on high ground so that it will not wash back into low pastures. All badly infested animals should be butchered and the livers thoroughly boiled or burned. Under no consideration should the raw liver be given to dogs, as the eggs are sure to be distributed by so doing. Raised drinking troughs should be provided, furnishing fresh water to which snails have not had access. A theory has been advanced to the effect that pastures bordering on the seashore are safe so far as fluke infestation is concerned. The station maintains several pastures less than a quarter of a mile from the sea which are badly infested with the embryo flukes. Results here have proved salt to be a very effective agent both in the treatment of infested animals and in the extermination of the embryos. However, it is believed that the distance from the seashore can affect the embryos or snails very little except in a typhoon season, when a large quantity of salt spray is blown across the island.

STOMACH WORMS OF CATTLE.

A parasite which as yet has not been positively identified, but is thought to be the *Hæmonchus contortus*, has been found here only in one case, that of a native cow. The cow manifested the symptoms characteristic of this parasite. On post-mortem examination, the parasites were found in large numbers in the abomasum. This has been the only case observed, and, as the parasite does not seem to be very widely disseminated, work on it must for the time necessarily remain suspended.

DISEASES OF SWINE.

With swine, as with the other domestic animals of Guam, the effect of internal parasites is of a serious nature. When looked at from an economic standpoint, the seriousness of parasitic infestation can hardly be overestimated. The average native hog is thin, undersized, and generally unthrifty. The presence of numerous blood-sucking parasites, or parasites that rob the host of intestinal nourishment, are largely responsible for this condition. The following conditions favor the production of a large number of the various parasites: Excessive rainfall, slight variation in temperature, use of low, swampy pastures containing stagnant water, and the tendency of the native live-stock owners to give no heed to proper food or water supplies.

THE COMMON LARD WORM.

A parasite commonly spoken of as the lard or kidney worm (*Stephanurus dentatus*) has been found in the kidneys proper, the perirenal fat, the lymph glands, the pancreas, the liver, and the lungs of hogs. The parasite establishes an inflammatory condition, followed by pus formation with the existence of multiple abscesses and finally a necrosis of tissue. The seat of invasion is surrounded by dense, fibrous connective tissue which has embedded in its mass numerous necrotic centers harboring the parasite and containing purulent material. In later stages, when the parasite can no longer be found, the purulent material assumes a caseous nature. The symptoms set up by this parasite are variable and confusing, because generally other parasitic infestations, such as flukes and lungworms, are present at the same time.

LUNGWORMS.

A parasite answering the description of the *Strongylus paradoxus* is frequently found infesting hogs. As far as observations have extended, it appears to be the most serious and fatal disease found among the swine of the island. The condition set up by this parasite

gives rise to symptoms of asthma and is commonly known by the people in all parts of the island by that name.

The chief symptoms are a bloody mucous discharge from the eyes and nostrils, eyelids swollen and inflamed, mucous membrane of the mouth anemic with purple blotches, back of ears soft and puffy, and ventral surface of the body red with purple patches. Most of the symptoms do not appear until about 12 hours before death occurs, and they are not constant in all cases.

After death, the lungs are badly congested and more or less consolidated. The bronchial tubes are filled with a quantity of frothy material. Numerous tubercles, found embedded in the lung tissue, contain the parasite, or its débris, along with purulent or caseous material. The bronchial lymph glands are enlarged and congested.

DISEASES OF POULTRY.

WHITE DIARRHEA.

Among chicks up to 6 weeks of age at the station, white diarrhea causes large losses. This disease has been described as existing in two forms, namely, the bacillary form and the coccidium form. Post-mortem and microscopic studies have shown that only the latter form exists here.

The following symptoms have been observed among the affected chicks at this station: Position stilted; attitude dull, sleepy, and listless; eyes closed a great portion of the time; wings drooping; head generally drawn well back; back bowed and shortened; abdomen pendulous and full behind; discharge from bowels thin, white, frothy, and sticky, matting together the feathers around the vent.

Upon post-mortem examination the liver is found to be somewhat paler than normal, friable, with areas of congestion. The gall bladder is usually much distended. The unabsorbed yolk in some cases fills the greater portion of the abdominal cavity. The intestines are usually almost empty of feces but contain considerable gas, while the cloaca is in many cases filled with a white, cheesy material. Some disease disturbance is always found affecting the ceca, which may be bulging with yellowish, semifluid ingesta, or may be filled with solid material and a considerable gas formation, but most often with a hard, blood-stained, caseous substance. In many cases the mucous membrane of the wall of the ceca is almost totally destroyed, leaving only the transparent, serous coat.

The station has had considerable success in combating white diarrhea. In the first place, the houses and yards were cleaned daily, and all refuse was burned. The chicks were kept in the incubator at least 52 hours after hatching, during which time they received no food but were given on the last day and thereafter for six weeks

twice daily medicated drinking water made up as follows: To 1 gallon of bichlorid of mercury solution, 1:10,000, was added 3 grains of citric acid and one 30-grain sulphocarbolate tablet.

On April 14, 1915, hatch No. 12, consisting of 56 strong, hardy chicks, was taken from the incubator, in which it had remained 52 hours after hatching, and divided into two lots of 28 chicks each. Pen No. 1 was given a morning feed of bread crumbs slightly moistened with the antidiarrhea medicine noted above. The medicated water was also given for their drinking water throughout the day. Pen No. 2 was given no medicinal treatment. The summarized results show that at the end of 15 days of treatment 2 chicks had died from white diarrhea in pen No. 1, and the remaining 26 chicks were strong and hardy, while in pen No. 2, 26 chicks had died from white diarrhea, and the remaining 2 chicks were affected with the disease and were stunted and emaciated. The chicks in both pens did well until the fourth day, when two cases of diarrhea appeared in pen No. 1. At the end of the first week the 22 chicks in pen No. 2 were less active and alert and less eager for feed than the 27 chicks remaining in pen No. 1.

All of the chicks hatched at the station since that date have been given medicinal treatment in their drinking water, and the losses from white diarrhea have not averaged more than two chicks per hatch. In the absence of proper treatment and the presence of such predisposing causes as improper brooding and poor feeding the mortality will run between 90 and 100 per cent. By eliminating all predisposing causes and using the treatment above recommended the mortality should be reduced to 5 per cent or less.

CHICKEN POX OR SOREHEAD.

Chicken pox is the most widely disseminated poultry disease on this island (Pl. VII, fig. 1). The disease generally makes its appearance near the close of the dry season, or immediately following the first heavy rains of the wet season. Chicks at this time are usually in poor condition and susceptible to any disease.

The first symptom noted is the appearance of wartlike nodules, brown in color and matted down to the skin by a sticky exudate which gives off an offensive odor. These scabs are located on the comb, wattles, eyelids, face, angle of the mouth, ear lobes, and, in fact, all parts not protected by feathers. Only in rare cases does the disease affect the feathered portion of the fowl. The scabs vary greatly in size, some being not more than a millimeter in diameter, others covering the entire head. Where the angle of the mouth is affected, the disease may ultimately find its way to the intestines and here set up a diseased condition. Where the eyelids are badly affected, the

disease becomes especially serious, rendering the bird blind, and resulting in starvation, since the chicken is unable to locate its food.

Mosquitoes, chicken lice, and mites are held to be factors in transmitting the disease, and cockfighting in Guam doubtless plays an important part in its spread. Any abrasion of the skin affords an excellent avenue of entrance for the germ of this disease.

CHOLERA.

Two outbreaks of chicken cholera were investigated during the past year. From reports here it seems safe to say that cholera has done more to discourage the poultry industry than any other factor. The symptoms and post-mortem findings have been similar to those in the United States, and consequently it does not seem necessary to go further into detail.

DIPHThERITIC ROUP.

Diphtheritic roup is present in all parts of the island (Pl. VII, fig. 2). In most cases, chicks between the ages of 2 and 6 months are affected, although it is not uncommon to see the disease manifesting itself among mature fowls.

Investigational work here has shown as many as 50 per cent of a brood of young chicks to have been affected with diphtheritic roup, and the mortality among untreated chicks has been as high as 90 per cent.

On this island, the presence of rain and dampness seems to play no important part in producing this disease. This is shown by the fact that the disease appeared this past year well after the dry season had set in and has remained stubbornly and persistently through the past three exceedingly dry months. The disease first appeared at this station when chicks about 2 months old were placed in a house and run which had previously been occupied by mature fowls. The chicks were allowed to seek shade under the house where the soil was dry and dusty.

While the mucous membranes of the eyes, nostrils, and mouth are most often affected, the disease has been found in the crop, proventriculus, and gizzard, setting up in these places a catarrhal condition. The first symptom noted is an acute conjunctivitis of the mucous membranes of the eye (usually appearing in but one eye at first, but in most cases affecting the other eye later). The affected eye is watery, with a slight watery discharge from the nostrils. A thick catarrhal product, white in color, soon begins to accumulate in the eye, while the nostrils become plugged with a thick, caseous material. Ulcerated areas, white or yellowish-white in color, appear in the mouth. The bird becomes weak, dull, and emaciated, with



FIG. 1.—EFFECT OF SOREHEAD OR CHICKEN POX.



FIG. 2.—EFFECT OF DIPHTHERITIC ROUP.



FIG. 3.—EFFECT OF TAPEWORM INFESTATION.

POULTRY DISEASES IN GUAM.



impaired appetite and drooping wings. Diarrhea is usually present. In the last stages of the disease the accumulation of white, caseous material between the lids is so great as to cause a great bulging out of the eye, the maxillary sinus is often swollen, and the diphtheritic areas in the mouth have become so extensive that the swallowing of food is impossible.

Post-mortem findings show the eye filled with a white, cheesy material and the nasal chambers occluded with this caseous substance, while extensive white or yellowish-white diphtheritic patches are found in the mouth. The mucous membrane of the eye shows acute conjunctivitis. The eyeball itself is found to be completely destroyed in many cases. The diseased mucous membrane presents a necrotic granular and pitted appearance. In some cases the proventriculus and gizzard show a sloughing catarrhal condition of their mucous membranes. The toxins produced by these diseased conditions are of a very destructive nature, as the condition of the eye, nostril, and mouth indicates. Microscopic examination of the diseased tissue reveals cellular infiltration.

An experiment for testing the value of bicarbonate of soda and argyrol in the treatment of diphtheritic roup was undertaken. Hatch No. 8 of 78 chicks was divided into two lots. Fifty-five per cent of the chicks were affected with diphtheritic roup. In lot No. 1, 10 per cent argyrol was used in the eyes of all the chicks as prophylactic treatment once each day. The eyes of all diseased chicks in lot No. 2 were cleaned of all caseous material and irrigated with a 20 per cent solution of bicarbonate of soda, after which they were flushed out well with 20 per cent argyrol. The membranes covering the ulcers of the mouth were removed and the raw surface painted with tincture of iodine or burned with a stick of silver nitrate, depending upon the nature of the ulcer. Other than the prophylactic treatment, the chicks of lot No. 1 were not treated, and the disease was allowed to take its course. At the end of 30 days 25 chicks had died out of lot No. 1 and 19 chicks had died out of lot No. 2. The following summarized conclusions seem justifiable from the data obtained: The application of 10 per cent argyrol in the eyes of healthy chicks once daily proved of no practical value. The excessive secretion and constant flow of tears in the eyes of a fowl so dilutes and so rapidly carries away this prophylactic agent as to render its medicinal properties of little consequence. The curative treatment proved to be almost as valueless. In 24 hours after a thorough treatment the diseased condition would be equally bad and in many cases more exaggerated. Better results have been obtained through administering this treatment three times daily than from any other used.

INTERNAL PARASITES OF POULTRY.

Poultry in general, but more especially young chicks, are found to be badly infested with internal parasites on this island. Among the parasites found are several species of tapeworm, the common roundworm, the ceca worm, small round worms which inhabit the proventriculus, and at least one kind of eye worm.

TAPEWORMS, COMMON ROUNDWORMS, AND CECA WORMS.

In considering the life history of tapeworms, some investigators have believed the earthworm to be the intermediate host, while other investigators have held the common house fly responsible for acting as the carrier of the cystic stage of at least certain species of the tapeworm. The experience here during the past dry season would lead us not to regard the earthworm as an intermediate host, because the chicks infested were confined in a small yard which was very dry and dusty. Flies and other insects were present in abundance. Lice and mites infested the house for a short time and might be considered a possible factor in the life history of certain of these parasites.

The following symptoms are observed in chicks between the ages of 2 and 6 months which were seriously infested with tapeworms and roundworms: The appetite becomes impaired and the body emaciated; the chick presents a generally unthrifty appearance, with the wings drooping and the feathers ruffled; and, in the last stages, the bird is found resting on its sternum, its head drawn back or tucked under the wing, with its general attitude dull, sleepy, and listless (Pl. VII, fig. 3). Diarrhea is often present, and the feces are often frothy and yellowish in color. A microscopic examination of the feces shows the presence of many eggs of the roundworm and very often segments of the tapeworm.

Post-mortem examinations show the roundworms, when occurring in large numbers, throughout the intestinal tract. The tapeworms are most often found in the small intestines, where they are often present in such large numbers as to completely occlude the lumen of the intestines. Ceca worms, although apparently of little harm, are found in at least 80 per cent of the dead birds. The intestines are found to be pale and shrunken in places and to show congested areas in others. In parts inhabited by the parasites, the mucous membrane shows a catarrhal condition. Fowls infested with the nodular tapeworm show, on the serous surface of the intestine, nodular elevations varying in size from a pinhead to a garden pea. These nodules, which contain a firm, yellow substance, are also noticeable when the mucous surface is viewed, and this surface may also show a pitted condition. Most chicks infested with roundworms were also found to be more or less infested with tapeworms, and vice versa.

An experiment was conducted for the treatment of tapeworms and roundworms on chicks 3 months old for determining the relative effectiveness of 1 dram turpentine, one-half grain thymol, 1 grain santonin, and 12 minims fluid extract of male fern. The results of the experiment showed all medicines to be more or less effective, although the thymol treatment proved most efficient when used for the two parasites.

A second experiment with 64 chicks, all more or less infested with intestinal worms, was conducted. Four chicks showing symptoms of advanced parasitic infestation and eight chicks affected with diphtheritic roup were isolated from the remainder of the flock. Thymol in one-half grain doses was given to the remaining 52 chicks. Epsom salts was administered before and after the treatment. These chicks were left in the house in which they were treated for two days after the treatment. The house was cleaned and disinfected thoroughly each day. At the end of the second day the chicks were moved directly to a new house, which was located on new ground. But two chicks from this lot died, and both of these were badly affected with diphtheritic roup. On post-mortem examination one of these chicks was found to have a few of the ceca worms. All the other chicks proved to be free from intestinal worms.

In the treatments it has been found much more convenient and less dangerous to give medicines in the form of pills than in a liquid state.

STOMACH WORMS.

At this station three cockerels six months of age have died, after showing the following symptoms: A peculiar, weak, unsteady staggering from one side to the other when walking or running; drooping wings; extreme weakness; and a state of disorientation. Two of the birds affected developed the condition known as "wry-tail." The appetite was not badly impaired. The duration of the disease was from two to four weeks and it proved fatal to the three cockerels affected.

The lungs on post-mortem examination showed several dark and congested areas, in which were embedded tubercles containing a caseous substance. No parasites could be found in the lungs, but the caseous material was thought to be the débris of a parasite. From 15 to 20 small roundworms from one-fourth to one-half inch in length were firmly attached to the walls of the stomach. A few common roundworms were found in the small intestine. The liver was softened and presented a parboiled appearance. A large blood clot, extending around the entire eyeball, was found in an eye of one of the birds. The brain was badly congested. From four to eight small, threadlike worms (probably Manson's eye worm) about

one-fourth inch in length were found under the nictitating membrane. Death is thought to have been the result of a migrating parasite.

Eighteen per cent of the chicks between 4 and 6 months of age that died at this station were found on post-mortem examination to be infested with a nematode (probably *Tetrameres fissispinus*) embedded in the walls of the proventriculus. A serious catarrhal condition affected the mucous membrane of the stomach, the walls of the organ being thickened to the extent of almost closing the lumen. The worm resembled a small blood clot about the size of a raspberry seed buried in the walls of the stomach when either the mucous or serous surface of that organ was viewed. From 6 to 47 worms have been

found infesting a stomach. Although the worms set up a serious condition, the prevalence of diphtheritic roup among the chickens of that age was so extensive as to make it impossible to attribute death in any case to the worms. Figure 4, *a*, shows the worm as it appeared under a magnifying glass. Figure 4, *b*, *c*, *d*, show the caudal and cephalic extremities of the worm, and also the eggs, magnified 430 diameters.

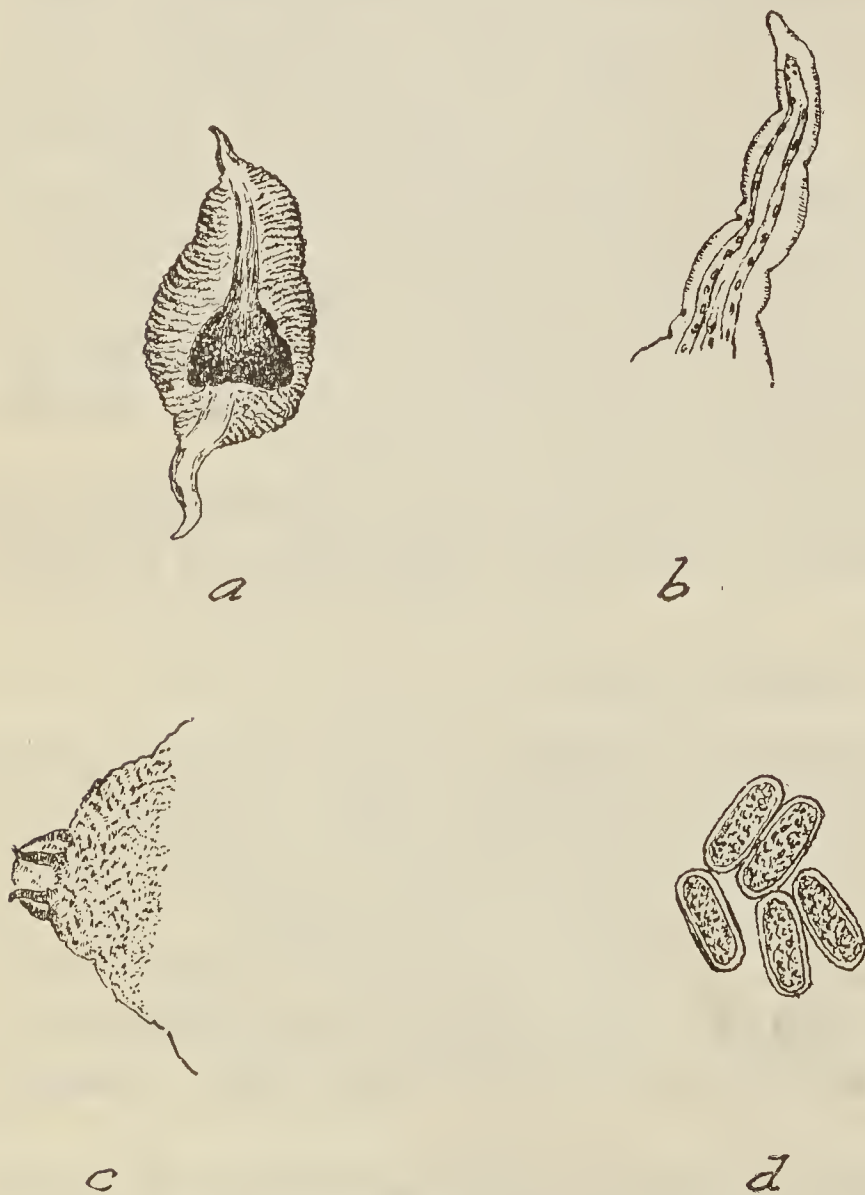


FIG. 4.—Worm and eggs from chicken's stomach (probably *Tetrameres fissispinus*): *a*, Female, enlarged; *b*, caudal extremity ($\times 430$); *c*, cephalic extremity ($\times 430$); *d*, eggs ($\times 430$).

THE EYE WORM.

An eye worm (resembling the Manson's eye worm) is commonly found infesting

the native fowls. The parasites in the eyes of a mature fowl seem to affect the general conditions of the bird very little, but in the eyes of a young chick they cause a much more serious trouble. At first the eye is watery, later inflammation sets in, and finally a caseous material accumulates under the eyelids and in the tear ducts.

There has been opportunity to visit but two flocks badly infested with the eye worm, and the work has not been extensive enough to

warrant any positive conclusions regarding the disease. About one-third of the chicks of these flocks were badly affected with diphtheritic roup, and it is, therefore, difficult to decide as to just what extent the parasite was responsible for the diseased condition present and whether it was in any case the direct cause of fatalities. The worm can at least be held responsible for producing an inflammation of the eye which makes the fowl an easier prey to diphtheritic roup.

EXTERNAL PARASITES OF POULTRY.

Three external chicken parasites have been found on this island, namely, two species of lice, *Menopon pallidum* and *Goniocotes gigas*, and one species of mite, *Dermanyssus gallinae*.

APICULTURAL NOTES.

By P. NELSON.

An abundance of pollen for brood rearing and a satisfactory flow of nectar marked the year just passed as a very satisfactory one from the beekeeper's standpoint. The farmer of Guam has to contend with many pests and diseases affecting his crops and live stock, but fortunately, diseases affecting honeybees, such as American and European foul brood, are unknown here. Although the dragon fly is plentiful on the island, it does not appear to prey upon bees, as in some parts of Florida and Australia, where these flies have worked havoc with the beekeeping industry, forcing many beekeepers to move their apiaries to other localities. This island is overrun with ants, but this pest does not seem to be very troublesome to the honeybee so long as good, strong colonies are maintained, and it is not necessary to place the hives on specially constructed stands to keep ants from coming into contact with the hives.

A small shed, 7 by 16 feet, with galvanized iron roof, was constructed early in the year in order to shelter the hives from the heavy rains and intense sun. Hives manufactured in the United States from soft woods deteriorate rapidly in this humid climate if not well painted and protected from the weather. A two-frame automatic extractor, a queen-rearing outfit, and several additional hives have been added to the station equipment during the year.

In an endeavor to develop beekeeping and to interest the younger generation, the governor of Guam has taken preliminary steps to have beekeeping introduced as a study in connection with the school garden work, and has authorized the purchase of a supply of hives and equipment. This station furnished the department of education with four nuclei. From these the school colonies are to be increased until sufficient numbers are on hand to supply all of the schools in the outlying districts.

The bureau of agriculture of the Philippine Islands has made repeated attempts to introduce the honeybee from the United States, but with such unsatisfactory results that arrangements were made with this station to rear a number of colonies in hives furnished by that bureau. Early in the year 10 colonies were shipped, and these colonies arrived in Manila apparently in good condition. In addition to these one colony was furnished to a private individual residing in Manila, and four nuclei were furnished to a private individual in Guam.

The native method of handling bees is similar to that practiced 60 years or more ago before the Langstroth hive was brought before the public. Whenever swarms are hived, old packing boxes are brought into use, chiefly because they are always at hand and represent no cash outlay. When these box hives are robbed of honey, through the absence of frames, such rough treatment is given the bees that it usually ends in the death of the queen and the loss of the whole brood. Generally the would-be beekeeper loses his enthusiasm because of the stings received during the operation.

The writer has had considerable success with bees, and owns 60 colonies, distributed in five localities of the island, as follows: Twenty-one at Yigo, 5 at Santa Rosa, 8 at Leguan, 20 at Agana (San Ramon), and 6 at Anigua.

During the past season all have done well, though those at Yigo and Santa Rosa have done considerably better than the others. A record of production covering 19 colonies situated at Yigo showed that 1,680 pounds of surplus honey was extracted from January to May, making an average of 88 pounds per colony, which compares favorably with the production in many localities of the United States. In December one colony was placed at Santa Rosa, and later was increased to four by dividing. In May these colonies were fairly strong, and produced 224 pounds of surplus honey, making an average of 56 pounds of honey in addition to the increase of three colonies.

The single colony of honeybees introduced from Hawaii in 1907 throve so well that there are now thousands of colonies of wild bees in hollow trees throughout the forests, as the progeny of this one queen. From the strength of some of them, it does not seem that inbreeding has done them any harm. The natives fell many of these trees to obtain the honey they contain, and thus many times a valuable tree will be destroyed for a few cents' worth of honey. The writer has practiced with much success a method of removing honey and bees from hollow trees.¹ This method is as follows: A small colony or nucleus is placed in a hive and taken to the tree from

¹ Root, A. I. and E. R. A B C and X Y Z of Bee Culture. Medina, Ohio.

which the bees are to be removed. A stand is constructed in such a position as to place the entrance of the hive in as close proximity to the flight hole as possible. The flight hole in the tree is covered with wire screen or boards, and provision is made in this cover for a Porter bee escape or wire cone, affording an exit for the bees but permitting no entrance from without. Several of these escapes work to good advantage in emptying a tree. The returning bees, loaded down with pollen and nectar, failing to find entrance to their old home, soon enter the hive on the stand, and, as this colony is weak, there is very little trouble. The bees are left to work out their own salvation, and in about one month's time all the brood in the tree will have hatched. The queen, left alone, soon dies. Then the wire screen or covering can be removed from the opening in the tree and the bees allowed to rob their old home, which they will proceed to do in a very short time. By this method the tree, bees, and honey are all saved, with no disagreeable labor attached. Last year the writer removed nine colonies from trees within a radius of half a mile by this method, and one colony produced over 250 pounds of honey.



